AI for Investment Analysis

Robo-Advisors and AI Chatbots

Min-Yuh Day
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http://mail.tku.edu.tw/myday/
2020-03-18
<table>
<thead>
<tr>
<th>週次 (Week)</th>
<th>日期 (Date)</th>
<th>內容 (Subject/Topics)</th>
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<tr>
<td>1</td>
<td>2020/03/04</td>
<td>人工智慧投資分析課程介紹</td>
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<tr>
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<td>(Course Orientation on AI for Investment Analysis)</td>
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<td>2</td>
<td>2020/03/11</td>
<td>AI 金融科技: 金融服務創新應用</td>
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<td>日期 (Date)</td>
<td>內容 (Subject/Topics)</td>
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<td>教師彈性補充教學</td>
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Robo-Advisors and AI Chatbots
Outline

• AI Robo-Advisor in FinTech
• AI Chatbot for Conversational Commerce
• AI Humanoid Robo-Advisor
AI Robo-Advisor in FinTech
AIWISFIN
AI Conversational Robo-Advisor
(人工智慧對話式理財機器人)
First Place, InnoServe Awards 2018

https://www.youtube.com/watch?v=sEhmyoTXmGk
2018 The 23\textsuperscript{th} International ICT Innovative Services Awards (InnoServe Awards 2018)

- Annual ICT application competition held for university and college students
- The largest and the most significant contest in Taiwan.
- More than ten thousand teachers and students from over one hundred universities and colleges have participated in the Contest.

https://innoserve.tca.org.tw/award.aspx
IMTKU
Emotional Dialogue System
for
Short Text Conversation
at
NTCIR-14 STC-3 (CECG) Task
IMTKU Textual Entailment System for Recognizing Inference in Text at NTCIR-9 RITE

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Chun Tu

NTCIR-9 Workshop, December 6-9, 2011, Tokyo, Japan
IMTKU Textual Entailment System for Recognizing Inference in Text at NTCIR-10 RITE-2

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Chun Tu
Hou-Cheng Vong
Shih-Wei Wu
Shih-Jhen Huang

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IMTKU Textual Entailment System for Recognizing Inference in Text at NTCIR-11 RITE-VAL

Tamkang University

2014

Yu-Hsuan Tai
Cheng-Chia Tsai

Huai-Wen Hsu
Yu-An Lin
Shang-Yu Wu
Yu-Hsuan Tai

Min-Yuh Day
Ya-Jung Wang
Che-Wei Hsu
En-Chun Tu

NTCIR-11 Conference, December 8-12, 2014, Tokyo, Japan
2016
IMTKU Question Answering System for
World History Exams at NTCIR-12 QA Lab2

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Yu-Ming Guo Yue-Da Lin Wei-Ming Chen Yun-Da Tsai Cheng-Jhih Han Yi-Jing Lin Yi-Heng Chiang Ching-Yuan Chien

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NTCIR-12 Conference, June 7-10, 2016, Tokyo, Japan
2017
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Wanchu Huang  Shi-Ya Zheng  I-Hsuan Huang  Tz-Rung Chen  Min-Chun Kuo  Yue-Da Lin  Yi-Jing Lin
IMTKU Emotional Dialogue System for Short Text Conversation at NTCIR-14 STC-3 (CECG) Task

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NTCIR-14 Conference, June 10-13, 2019, Tokyo, Japan
Robo-Advisors
FinTech high-level classification

- Lending
- Payments
- Robo Advisors
- Analytics
- Others

- Profile
- Advice
- Re-Balance
- Indexing

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Betterment is an online financial advisor built for people who refuse to settle for average investing. People who demand better. People like you.

Right for every type of investor

New investor
I'm new to investing, or am looking for some guidance.

Hands-off investor
I invest, but don't have the time or desire to do it myself.

Hands-on investor
I'm a confident, hands-on investor looking for an optimal solution.

https://www.betterment.com/
From Algorithmic Trading to Personal Finance Bots: 41 Startups Bringing AI to Fintech

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
From Algorithmic Trading To Personal Finance Bots: 41 Startups Bringing AI To Fintech

AI in Fintech

41 Startups Bringing Artificial Intelligence To Fintech

General Purpose/ Predictive Analytics

AYASDI  
Kenshco  
DataRobot  
H2O  

Quantitative Trading

sentient technologies  
clone algorithms  
Alpaca  

AI Assistants/Bots

KASIST  
TRIM  
Penny  
INSURIFY  
SURE.

Credit Scoring

TypeScore  
Aire  
Zestfinance  
ADF  
Creame  

Market Research & Sentiment Analysis

indico  
acuity  
Lucena Quantitative Analytics  
NUMERAI  

Blockchain

Skry  
EUCLID

Personal Banking

personal  
SBDA  

Debt Collection

Feedzai  
TrueAccord

Fraud Detection

Biocatch  
Less Friction, Less Fraud.

Search Engine

alphasense

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

General Purpose/Predictive Analytics

- AYASDI
- Digital Reasoning
- H2O
- KENSHO
- cortical.io
- Numenta
- DataRobot
- Nervana Systems

Market Research & Sentiment Analysis

- indic\n- acuity
- Lucena Quantitative Analytics
- NUMERAI
- Dataminr

Search Engine

- alphasense

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

**Quantitative Trading**
- sentient technologies
- CLONE ALGO
- Alpaca
- WALNUT ALGORITHMS

**AI Assistants/Bots**
- KASIST
- TRIM
- Penny
- INSURIFY SURE.

**Credit Scoring**
- TypeScore
- aire
- creditvidya
- zest finance
- ADF
- APPLIED DATA FINANCE
- Wecash

**Blockchain**
- Skry
- EUKLID

**Debt Collection**
- TrueAccord

**Fraud Detection**
- feedzai
- BIOPROOF
  - Less Friction. Less Fraud.

**Personal Banking**
- personetics
  - TAKING DIGITAL BANKING PERSONAL
- SBDA group

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Financial Technology

FinTech

“providing financial services by making use of software and modern technology”

Source: https://www.fintechweekly.com/fintech-definition
Financial Services
Financial Services

Source: http://www.crackitt.com/7-reasons-why-your-fintech-startup-needs-visual-marketing/
FinTech: Financial Services Innovation

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Financial Services Innovation

1. Payments
2. Insurance
3. Deposits & Lending
4. Capital Raising
5. Investment Management
6. Market Provisioning

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Investment Management

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Market Provisioning

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
The New Alpha: 30+ Startups Providing Alternative Data For Sophisticated Investors

New sources of data mined by startups like Foursquare, Premise, and Orbital Insight are letting investors understand trends before they happen.

Source: https://www.cbinsights.com/blog/alternative-data-startups-market-map-company-list/
The New Alpha: 30+ Startups Providing Alternative Data For Sophisticated Investors

Alternative Data Sources

- Satellite Data
  - Orbital Insight
  - spire
  - rezatec
  - Ursa
  - RS Metrics
  - urtheCast
  - Planet Labs
  - Windward

- Web/App/Social Media Data
  - yipit
  - 7PARK
  - App Annie
  - Selerity
  - Dataminr
  - DATA SIFT

- Weather Data
  - aclima
  - UNDERSTORY
  - THE CLIMATE CORPORATION

- Location/Foot Traffic
  - Foursquare
  - Placemaker
  - AirSage
  - STREET LIGHT DATA
  - Placed

- Alternative Data Monetizers/Aggregators
  - Eagle Alpha
  - Quant on Data
  - Sentieo
  - DISCERN

- Credit Card Transactions
  - earnest
  - SECOND MEASURE
  - ynext
  - Envestnet

- Alternative Credit
  - first access
  - cigniti
  - FACTOR TRUST

Source: https://www.cbinsights.com/blog/alternative-data-startups-market-map-company-list/
AI Chatbot for Conversational Commerce
Conversational Commerce
Chatbots: Evolution of UI/UX

Source: https://bbvaopen4u.com/en/actualidad/want-know-how-build-conversational-chatbot-here-are-some-tools
Chatbot
Dialogue System
Intelligent Agent
Chatbot

Source: https://www.mdsdecoded.com/blog/the-rise-of-chatbots/
Dialogue System

Overall Architecture of Intelligent Chatbot

Dialogue Subtasks

Dialogue subtasks

- Dialogue Generation
  - 8 leaderboards
  - 27 papers with code

- Dialogue State Tracking
  - 2 leaderboards
  - 21 papers with code

- Goal-Oriented Dialog
  - 13 papers with code

- Task-Oriented Dialogue Systems
  - 10 papers with code

- Short-Text Conversation

- Dialogue Understanding
  - 5 papers with code

- Short-Text Conversation
  - 4 papers with code

- Goal-Oriented Dialogue Systems
  - 2 papers with code

- Task-Completion Dialogue Policy Learning
  - 2 papers with code

- Visual Dialogue
  - 2 papers with code

Source: https://paperswithcode.com/area/natural-language-processing/dialogue
Can machines think?

(Alan Turing, 1950)

Chatbot

“online human-computer dialog system with natural language.”

From E-Commerce to Conversational Commerce: Chatbots and Virtual Assistants

Source: http://www.guided-selling.org/from-e-commerce-to-conversational-commerce/
Conversational Commerce: eBay AI Chatbots

Hotel Chatbot

**Intent Detection**

**Intents**
An intent performs an action in response to natural language user input.

**Utterances**
Spoken or typed phrases that invoke your intent.

**Slots**
Slots are input data required to fulfill the intent.

**Slot Filling**

**BookHotel**

I’d like to book a hotel

Sure, which city?

New York City

What date are you leaving?

November 30th, 2016

Are you sure you want to book the hotel in NYC?

Yes

Thank you. The reservation went through successfully.

**Fulfillment**
Fulfillment mechanism for your intent.

Source: https://sdtimes.com/amazon/guest-view-capitalize-amazon-lex-available-general-public/
H&M’s Chatbot on Kik

Source: http://www.guided-selling.org/from-e-commerce-to-conversational-commerce/
Uber’s Chatbot on Facebook’s Messenger

Uber’s chatbot on Facebook’s messenger - one main benefit: it loads much faster than the Uber app

Source: http://www.guided-selling.org/from-e-commerce-to-conversational-commerce/
Savings Bot

Mastercard Makes Commerce More Conversational

Chatbots

Bot Maturity Model

Customers want to have simpler means to interact with businesses and get faster response to a question or complaint.
Bot Life Cycle and Platform Ecosystem
The Bot Lifecycle

The Lifecycle of a bot

Source: https://chatbotsmagazine.com/the-bot-lifecycle-1ff357430db7
The bot platform ecosystem
and the emerging giants

Nearly every large software company has announced some sort of bot strategy in the last year. Here’s a look at a handful of leading platforms that developers might use to send messages, interpret natural language, and deploy bots, with the emerging bot-ecosystem giants highlighted.

General AI agents with platforms
Developer access available now or announced

Source: https://www.oreilly.com/ideas/infographic-the-bot-platform-ecosystem
Bot frameworks and deployment platforms

- Wit.ai
  - Facebook
- BotKit
- Howdy
- Api.ai
  - Google
- Pandorabots
- Chatfuel
- Automat
- Bot Framework
  - Microsoft
- MindMeld
- Gupshup
- Sequel

Source: https://www.oreilly.comideas/infographic-the-bot-platform-ecosystem
# Messenger Bot Landscape

**Source:** https://medium.com/@RecastAI/2017-messenger-bot-landscape-a-public-spreadsheet-gathering-1000-messenger-bots-f017fdb1448a

## Food
- The Wise Parent
- Pizzahut
- Persistance Kitchen
- Hungry
- Foodie

## Communication
- Tango
- Typeform
- Aseeya
- Trigify
- Refugo
- Rescue
- Messenger Match
- Senkay
- Lang-LearnBot
- Chat Club
- Lingvo Translate
- Swadheraji
- U-Report Global
- Trigg

## Utilities
- Pancho
- Cardbot
- Smokey
- DotCom
- Serve Messenger

## Design
- ColorBot
- Connie Digital
- AWAYMEE
- Mr. Norm\n- Graphic Design
- SnailBot

## News
- CNN
- TIME
- Digg
- WSJ
- Reddit Bot
- Al-Jazeera

## Developer Tools
- HackerOne
- Winedeltra

## Education
- Genius
- Kinchii

## Personal
- M
- Asistent
- Operator
- Uber
- Swifty
- AskVoice

## Analytics
- SISense
- StockTape
- Pypa Insights
- DAM
- BuzzLogger
- Trading Bot

### Travel
- Gobase
- RTM
- British Airways
- Spann Explorer
- Austrian Airlines

### Entertainment
- Spotify
- Kim Kardashian
- La Bilingue
- S0 Cent
- Caudilla Pal
- Linsley Lehan
- Marcus S
- MTV News
- Ansell A Ingessa
- Red Bull TV
- StarTalk
- Star Wars Bot
- Cinem
- PoldoBot

### Developer Tools
- Rebbie
- Zivy

### Education
- MemorizerBot
- Anstein
How to Build Chatbots

END USER
- sends/receives message

MESSAGING PLATFORMS
- requests webhook URL / receives response

WEBHOOK

DATABASE
- query data from DB

APIs
- interact with API for data

BOT APPLICATION
- server handles requests via CGI

WEB SERVER
- NGINX
- APACHE

Chatbot Frameworks and AI Services

• Bot Frameworks
  – Botkit
  – Microsoft Bot Framework
  – Rasa NLU

• AI Services
  – Wit.ai
  – api.ai
  – LUIS.ai
  – IBM Watson

# Chatbot Frameworks

## Comparison Table of Most Prominent Bot Frameworks

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<thead>
<tr>
<th>Feature</th>
<th>Botkit</th>
<th>Microsoft Bot Framework</th>
<th>RASA NLU</th>
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<tbody>
<tr>
<td>Built-in integration with messaging platforms</td>
<td>✔️</td>
<td>✔️</td>
<td>✗</td>
</tr>
<tr>
<td>NLP support</td>
<td>✗</td>
<td>✗</td>
<td>✔️</td>
</tr>
<tr>
<td>NLP support</td>
<td>but possible to integrate with middlewares</td>
<td>but have close bonds with LUIS.ai</td>
<td></td>
</tr>
<tr>
<td>Out-of-box bots ready to be deployed</td>
<td>✔️</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>Programming Language</td>
<td>JavaScript (Node)</td>
<td>JavaScript (Node), C#</td>
<td>Python</td>
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## Comparison of Most Prominent AI Services

<table>
<thead>
<tr>
<th>Feature</th>
<th>wit.ai</th>
<th>api.ai</th>
<th>LUIS.ai</th>
<th>IBM Watson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free of charge</td>
<td>✓</td>
<td>✓ but has paid enterprise version</td>
<td>✓ it is in beta and has transaction limits</td>
<td>30 days trial then priced for enterprise use</td>
</tr>
<tr>
<td>Text and Speech processing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Machine Learning Modeling</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Support for Intents, Entities, Actions</td>
<td>Intents used as trait entities, actions are combined operations</td>
<td>Intents is the main prediction mechanism. Domains of entities, intents and actions</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pre-build entities for easy parsing of numbers, temperature, date, etc.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Integration to messaging platforms</td>
<td>web service API</td>
<td>also has facility for deploying to heroku. Paid environment</td>
<td>integrated to Azure</td>
<td>possible via API</td>
</tr>
<tr>
<td>Support of SDKs</td>
<td>includes SDKs for Python, Node.js, Rust, C, Ruby, iOS, Android, Windows Phone</td>
<td>C#, Xamarin, Python, Node.js, iOS, Android, Windows Phone</td>
<td>enables building with Web Service API, Microsoft Bot Framework integration</td>
<td>Proprietary language “AlchemyLanguage”</td>
</tr>
</tbody>
</table>

IMTKU System Architecture for NTCIR-13 QALab-3

- Question (XML)
- Question Analysis
  - JA&EN Translator
  - Stanford CoreNLP
  - Wikipedia
- Document Retrieval
- Answer Extraction
- Answer Generation
  - Word Embedding Wiki Word2Vec
- Answer (XML)

- Complex Essay
- Simple Essay
- True-or-False
- Factoid
- Slot-Filling
- Unique

NTCIR-13 Conference, December 5-8, 2017, Tokyo, Japan
System Architecture of Intelligent Dialogue and Question Answering System

1. User Question Input
   - RNN LSTM GRU
2. Dialogue Intention Detection
   - AIML Dialogue Engine
3. AIML Dialogue Engine
   - Real Time Dialogue API
4. System Response Generator
5. Question Analysis
6. Document Retrieval
7. Answer Extraction
8. Answer Generation
9. Answer Validation

Tools:
- Python NLTK
- Deep Learning TensorFlow
- Dialogue KB
- IR
- Deep Learning

APIs:
- Cloud Resource
- AIML KB
- Real Time Dialogue API
- System Response Generator
IMTKU Emotional Dialogue System Architecture

1. Retrieval-Based Model
2. Generation-Based Model
3. Emotion Classification Model
4. Response Ranking

NTCIR-14 Conference, June 10-13, 2019, Tokyo, Japan
The system architecture of IMTKU retrieval-based model for NTCIR-14 STC-3

Retrieval-Based Model

- Post
- Word Segmentation
- Keyword Boolean Query
- Corpus
- Building Index
- Solr Matching
- Distinct Result Data
- Emotion Matching
- Emotion Classification
- Word2Vec Similarity Ranking
- Retrieval-Based Response
The system architecture of IMTKU generation-based model for NTCIR-14 STC-3

**Generation-Based Model**

1. **Training Data**
   - Building Word Index
   - Word Embedding
   - Training Data Seq2seq model

2. **Post**
   - Word Segmentation
   - Short Text Emotion Classifier
   - Trained Model
   - Emotion Matching
   - Word2Vec Similarity Ranking

3. **Generation-Based Response**

**Generative Model**
The system architecture of IMTKU emotion classification model for NTCIR-14 STC-3

Emotion Classification Model

Corpus → Emotion Classification → Training Dataset → MLP, LSTM, BiLSTM → Testing Dataset → Emotion Classification Model → Emotion Prediction
The system architecture of IMTKU Response Ranking for NTCIR-14 STC-3

Response Ranking

1. STC3 Corpus
2. Chinese Segmentation using Jieba
3. Stop Words Removal
4. Word2Vec
5. 1.2 million data (300 dimensions)
6. Vector of Corpus
Short Text Conversation Task (STC-3)
Chinese Emotional Conversation Generation (CECG) Subtask

Source: http://coai.cs.tsinghua.edu.cn/hml/challenge.html
## NTCIR Short Text Conversation
### STC-1, STC-2, STC-3

<table>
<thead>
<tr>
<th></th>
<th>Japanese</th>
<th>Chinese</th>
<th>English</th>
</tr>
</thead>
<tbody>
<tr>
<td>NTCIR-12 STC-1</td>
<td>Twitter, Retrieval</td>
<td>Weibo, Retrieval</td>
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<tr>
<td>22 active participants</td>
<td></td>
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<tr>
<td>NTCIR-13 STC-2</td>
<td>Yahoo! News, Retrieval + Generation</td>
<td>Weibo, Retrieval + Generation</td>
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<td>27 active participants</td>
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<td>NTCIR-14 STC-3</td>
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</tbody>
</table>

- **Chinese Emotional Conversation Generation (CECG) subtask**
- **Dialogue Quality (DQ) and Nugget Detection (ND) subtasks**
- **Weibo, Generation for given emotion categories**
- **Weibo+English translations, distribution estimation for subjective annotations**

Source: [https://waseda.app.box.com/v/STC3atNTCIR-14](https://waseda.app.box.com/v/STC3atNTCIR-14)
Dialogue on Airline Travel Information System (ATIS)
The ATIS (Airline Travel Information System) Dataset


https://www.kaggle.com/siddhadev/atis-dataset-from-ms-cntk

<table>
<thead>
<tr>
<th>Sentence</th>
<th>what</th>
<th>flights</th>
<th>leave</th>
<th>from</th>
<th>phoenix</th>
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<tbody>
<tr>
<td>Slots</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>B-fromloc</td>
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<tr>
<td>Intent</td>
<td>atis_flight</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

Training samples: 4978
Testing samples: 893
Vocab size: 943
Slot count: 129
Intent count: 26
SF-ID Network (E et al., 2019)
Slot Filling (SF)
Intent Detection (ID)

A Novel Bi-directional Interrelated Model for Joint Intent Detection and Slot Filling

Intent Detection on ATIS

State-of-the-art

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<table>
<thead>
<tr>
<th>RANK</th>
<th>METHOD</th>
<th>ACCURACY</th>
<th>PAPER TITLE</th>
<th>YEAR</th>
<th>PAPER</th>
<th>CODE</th>
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<td>1</td>
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<td>0.9776</td>
<td>A Novel Bi-directional Interrelated Model for Joint Intent Detection and Slot Filling</td>
<td>2019</td>
<td></td>
<td></td>
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<tr>
<td>2</td>
<td>Capsule-NLU</td>
<td>0.950</td>
<td>Joint Slot Filling and Intent Detection via Capsule Neural Networks</td>
<td>2018</td>
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Source: [https://paperswithcode.com/sota/intent-detection-on-atis](https://paperswithcode.com/sota/intent-detection-on-atis)
Slot Filling on ATIS

State-of-the-art

Slot Filling on ATIS

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<td>A Novel Bi-directional Interrelated Model for Joint Intent Detection and Slot Filling</td>
<td>2019</td>
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<td>Capsule-NLU</td>
<td>0.952</td>
<td>Joint Slot Filling and Intent Detection via Capsule Neural Networks</td>
<td>2018</td>
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</table>

Source: https://paperswithcode.com/sota/slot-filling-on-atis
AI Humanoid
Robo-Advisor
AI Humanoid Robo-Advisor for Multi-channel Conversational Commerce

AI Portfolio Asset Allocation

AI Conversation Dialog System

Multichannel Platforms
- Web
- LINE
- Facebook
- Humanoid Robot
System Architecture of AI Humanoid Robo-Advisor
Conversational Model
(LINE, FB Messenger)
Conversational Robo-Advisor
Multichannel UI/UX
Robots

ALPHA 2

ZENBO
## Portfolio Performance in 2016

### Annual Portfolio Statistics

<table>
<thead>
<tr>
<th></th>
<th>Black-Litterman Portfolio - the LSTM Investor Views</th>
<th>Markowitz Portfolio</th>
<th>Equally Weighted Portfolio</th>
<th>S&amp;P 500 Index</th>
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</thead>
<tbody>
<tr>
<td><strong>Annual return</strong></td>
<td>16.151%</td>
<td>15.172%</td>
<td>12.428%</td>
<td>9.643%</td>
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<tr>
<td><strong>Annual volatility</strong></td>
<td>13.897%</td>
<td>14.365%</td>
<td>15.870%</td>
<td>13.169%</td>
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<tr>
<td><strong>Sharpe ratio</strong></td>
<td>1.14697</td>
<td>1.05534</td>
<td>0.81762</td>
<td>0.76492</td>
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<tr>
<td><strong>Stability</strong></td>
<td>0.82500</td>
<td>0.82515</td>
<td>0.82514</td>
<td>0.78754</td>
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<tr>
<td><strong>Max drawdown</strong></td>
<td>-10.105%</td>
<td>-10.465%</td>
<td>-12.529%</td>
<td>-10.306%</td>
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<tr>
<td><strong>Skew</strong></td>
<td>-0.35652</td>
<td>-0.52985</td>
<td>-0.56976</td>
<td>-0.36795</td>
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<td><strong>Kurtosis</strong></td>
<td>2.49845</td>
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<td><strong>Daily value at risk</strong></td>
<td>-1.688%</td>
<td>-1.750%</td>
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<tr>
<td><strong>Alpha</strong></td>
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<td><strong>Beta</strong></td>
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<td><strong>Information ratio</strong></td>
<td>0.10935</td>
<td>0.09129</td>
<td>0.04655</td>
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</tr>
</tbody>
</table>

Portfolio Cumulative Returns

Cumulative Returns: Portfolios

Cumulative Returns
Markowitz v.s. Black-litterment

Source: Min-Yuh Day, Jian-Ting Lin and Yuan-Chih Chen (2018), "Artificial Intelligence for Conversational Robo-Advisor", in Proceedings of the 2018 IEEE/ACM International Conference on Advances in Social Networks Analysis and Mining (ASONAM 2018), Barcelona, Spain, August 28-31, 2018
Summary

• AI Robo-Advisor in FinTech
• Chatbot for Conversational Commerce
• AI Humanoid Robo-Advisor
References